

The Effect of Some Physical Factors and Lead on Soil and Smoking Workers in Gas Stations in Kirkuk Governorate

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ABSTRACT

This study was completed in the city of Kirkuk. Environmental pollution with lead was studied in a number of government gas stations in Kirkuk Governorate, causing an increase in the rates of pollutants coming out of car exhaust, including the lead element in five sites, namely: Andalusia gas station, Al-Mutawra gas station, Baba Gurgur gas station, and Uqba bin Nafi gas station. The fifth site is the control site in the Domiz area in the south of the province. The research sampled the soil of these stations for a period of six months, a sample every month, starting from November 2022 until April 2023, and blood samples were taken for some smoking workers in those stations, as the concentration of the lead element in those samples was determined. Also, its effect on some blood parameters (C-RP, Pb) and pollution was studied by calculating the concentration of lead and some tests for the blood of people working in gas stations and those not working in them. The results of the study were determined by three main parts:

First: Quantitative results related to the amount of lead present in the soil for filling stations and control area. Second: Quantitative results of some physical factors of the soil of filling stations. Third: Physiological results of some blood tests for some workers in the stations of smokers and control group.

The quantitative results showed significant differences between the stations and the control area, as the results recorded the highest average concentration of lead in the soil (20.85 ± 0.35) ppm in the fourth station (Uqba bin Nafi) and the lowest average concentration (15.75 ± 0.34) ppm in the first station (Andalusia) and the average concentration in the control area was (11.51 ± 0.28) ppm. The physiological results, included tests such as C-RP, Pb are concerned with the blood of smoking workers in those stations of smokers and indicate the concentration of lead in it to know the extent of the impact of the amount of lead in the gas stations on the health and safety of people. The extent of the impact of smoking as a contributing factor in increasing the percentage of pollution and its impact on human health. The highest concentration of lead in smoking station workers was (31.9 ± 0.99) ppm and the lowest concentration was (27.6 ± 1.26) ppm.

INTRODUCTION

Environmental pollution is a serious problem for the humans in the modern era. It began with the start industry, mining and knowledge of energy sources such as coal and petroleum, including gases, waste, and many manmade chemical compounds that were not naturally present in the environment, such as pesticides of various kinds, agricultural fertilizers, plastics and industrial plastics(Albrecht, 2005). Heavy metal pollution is a serious problem because they the gather and accumulate within living ecosystems. The tremendous technological development has caused overuse of these elements which have reached a high level of danger, leaving a great effect on the environment, and man himself is one of the victims of environmental stress(Ariffin et al., 2017)

Soils are the natural receptor of heavy metals, and can be a means of converting them to the ecosystem when surface water leachates into groundwater in areas contaminated with them. They then move to plant tissues and reaches humans(Dixit et al., 2015).

Lead is one of the oldest known and most widely studied environmental(Chaichan & Abass, 2010). Although the USA and the European Union have banned lead as an additive to fuel for vehicles on the road, it is still used in gasoline in many countries in the Middle East including Iraq. Gas station workers constantly deal with leaded gasoline during their daily lives(Musso et al., 2004). Lead in the workplace comes from emissions in the form of fine particles that are inhaled and absorbed through the lungs, ingestion, or skin exposure(van Leuven et al., 2008). Recent research has shown that clinical or subclinical toxic effects can occur in a ratio of less than 50 µg/dl in the blood as human exposure to levels higher than the internationally permissible limit causes lead poisoning. The symptoms appear in the form of disorders in the nervous system, kidney damage, diseases in the digestive system and changes in blood cells, breaking them(Hess, 2014).

2. Materials and Methods

2.1 Location of the experiment

The study was conducted in the city of Kirkuk, which is located in northern part of Iraq, 240 km north of the capital Baghdad. Astronomically, the province is located at the intersection of latitude $-35^{\circ} 28'$ north of the equator with longitude $-44^{\circ} 23'$ east of Greenwich (Al-Azzawi, 2005), and is bordered to the west by the Hamrin mountain range. It is an oil-rich city. Its area is 9679 km².

This work studied five sites, four of which are gas stations, chosen because they are contaminated with heavy metals (especially lead) that are continuously emitted from the exhaust of cars in these stations because these stations are government stations that operate on a daily basis and for long periods of time. The fifth site is for the control subjects away from these sites in order to be less affected by the causes of pollution mentioned. These sites are:

- 1- The first site (Andalusia gas station / Rahim Oh)
- 2- The second location (Al-Mutawara Gas Station / Municipality Street)
- 3- The third site (Baba Gurgur gas station / Baghdad Road)
- 4- The fourth site (Uqba bin Nafi' station / Baghdad Road)
- 5- The fifth site (control site) Domiz area, south of the governorate

3-2 - Design of the experiment: -

First: - Dust and soil samples were collected at the mentioned stations, and the collection

process continued for 6 months from November of the year 2022 until April 2023. Measurements were made for physical features on them, and then the concentrations of the lead element were identified in all samples.

Second: - Blood samples were taken from some workers in the stations in Kirkuk. The concentration of lead in those samples were measured with its effect on some blood parameters. The samples were divided into two categories

The first category is 30 people working inside the stations aged (20-54) years for (0-15) years, where these ages were selected according to the years of experiences in these stations (smokers)

The second category is the control group. This group consists of 30 random non-smoker samples were selected from separate areas and the same ages were selected from 20-50. This group is compared with the first and second category to find out the significant differences between them.

2.2 Soil sampling process

Samples were collected from the mentioned sites at a depth of (0-20 cm) below the soil surface using a stainless-steel drill, as the samples were collected in sterile plastic bags and were collected from the same point for one site by one repeater per month. Then, the samples were transferred to the laboratory of the Department of Agriculture / Kirkuk for physical and chemical factors tests. Next, the samples were digested and transferred to the central laboratory / Tikrit University to measure the percentage of lead in them.

2.3 Environmental characteristics studied

2.3.1 Measurement of electrical conductivity (EC) and pH

EC and Ph of the hydro-soil extract were measured in a ratio of 1:5 using an EC-pH-meter after adjusting and calibrating the device according to the method reported by Richards (1969).

2.3.2 Measurement of lead in soil

The digested soil samples were placed in single-use cans and the tube of the Atomic Absorption Spectrometer was placed in these samples. The results were directly obtained, as this test was performed at Tikrit University \ Central Laboratories.

2.3.3. C-reactive protein evaluation

In this work, 100 microns of blood serum were placed in the Afias device with customized solutions prepared in advance by the device manufacturer and the result appeared after 10 minutes.

3.6.4 Blood lead level evaluation:

The 3 ml drawn blood was placed in test tubes containing an anticoagulant EDTA tube to measure the lead element in Baghdad / Medical City Department / Toxicology Department. The tubes were placed in the device for the dismantling of blood components KAHN-SHAKER (TKA_226) with vibratory movement for 30 minutes, which works to break down the blood components. After that, the blood was discharged into normal tubes called Plane and 2.5 ml of weak Trichloroacetic acid (TCA) was added and mixed well with wooden sticks inside the tube itself. Then, the tube entered the German-made UNIVERSAL 16 A centrifuge for 10 minutes at a speed of 3000 rpm (Haraguchi et al., 1991; Wilson et al., 1972). A clear transparent solution was obtained and read directly by the atomic absorption spectrophotometer (FLAME).

4. Results

Environmental outcomes

2.1.1 Electrical Conductivity (EC)

Table (1) recorded the highest value of EC in the second station by (2.09 mmols / cm³) in February and the lowest value in January in the third station by (0.252) mmols / cm. The table shows the average EC values in the four study stations and in the control station during the six months of the study that the highest average values in the second station reached (1.391) mmols / cm with a standard error of (0.11± which was statistically the highest among the stations. Yet, the average value was the lowest in the fourth station at (0.61) mmols / cm and with a standard error (0.09±), which is closer to the result of the control group in which the average values were (0.51) mmols/ cm with a standard error (0.10 ±),

Table (1) the electrical conductivity ratios of the soil

	Station 1	Station 2	Station 3	Station 4	Control	Mean ± SD
November	1.26	1.51	1.02	0.64	0.72	1.11 ± 0.18
October	0.93	1.17	0.87	0.75	0.38	0.93 ± 0.13
January	0.517	1.009	0.252	0.353	0.100	0.53 ± 0.17
February	1.32	2.09	1.18	0.97	0.99	1.39 ± 0.21
March	2.08	1.36	0.52	0.55	0.50	1.13 ± 0.26
April	1.97	1.23	0.48	0.42	0.38	1.03 ± 0.26
Mean ± SD	1.35 ± 0.14	1.39 ± 0.11	0.72 ± 0.11	0.61 ± 0.09	0.51 ± 0.10	1.02 ± 0.12
P-Value	0.018	<0.001	0.028	0.207		

3-1-1-4Ph

The value of Ph in ordinary soils ranges between (4-10) (Al-Nuaimi, 1990). The results of the current study show that the values of Ph were within the normal range. Table (2) reveal that the lowest value was (6.48) in the soil of the second station and the highest value was (7.83) in the soil of the first station. The soil was classified within the neutral soils to the oblique of the base and according to the American classification Soil Survey Division Staff (1993). In January, we recorded the highest average values of Ph by (7.19) with a standard error of (0.15±) and the lowest average values was in April by (6.77) with a standard error of (0.10±).

Table (2) shows the pH ratios in the soil

Mean ± SD	Control	Station 4	Station 3	Station 2	Station 1	
7.03 ± 0.15	7.5	7.15	7.4	6.5	6.64	November
6.96 ± 0.13	7.43	7.09	6.98	6.62	6.72	October
7.19 ± 0.15	7.28	7.09	7.04	6.73	7.83	January
6.90 ± 0.09	7.07	6.93	7.01	6.7	6.83	February
6.84 ± 0.10	7.07	6.92	6.95	6.54	6.75	March
6.77 ± 0.10	6.95	6.86	6.83	6.48	6.73	April
6.95 ± 0.11	7.21 ± 0.11	7.00 ± 0.08	7.03 ± 0.10	6.59 ± 0.07	6.91 ± 0.16	Mean ± SD
		0.005	0.028	0.002	0.018	P-Value

4.1.2.4 Lead concentration in plant soil

Table (3) show the existence of significant differences at the level of ($p \leq 0.05$) for the concentration of lead in the soil of the study stations compared to the control area. The first station had the highest concentration in the month of April by (19.1) parts per million and the lowest concentration in a month in February by (13.3) parts per million and the second station was the highest in the concentration in March (19.7) ppm and the lowest concentration in February by (11.4) ppm. In the third station, March had highest concentration (23.0) ppm and the lowest in January (16.5) ppm. The fourth station recorded the highest concentration in April (23.0) ppm, the lowest concentration in November (17.9) ppm, while the control area recorded the highest concentration in April by (13.3) ppm and the lowest concentration in January (9.6).

Table (3): Lead concentration in plant soil

	Station 1	Station 2	Station 3	Station 4	Control	Mean $\pm$ SD
November	15.9	16.9	18.4	17.9	13.2	16.46 $\pm$ 0.33
October	15.2	14.7	17.2	22.4	11.0	16.10 $\pm$ 0.48
January	14.2	13.8	16.5	20.3	9.6	14.88 $\pm$ 0.46
February	13.3	11.4	20.1	18.6	10.8	14.84 $\pm$ 0.48
March	16.8	19.7	23.0	22.9	11.2	18.72 $\pm$ 0.52
April	19.1	18.3	20.5	23.0	13.3	18.84 $\pm$ 0.44
Mean $\pm$ SD	15.75 $\pm$ 0.34	15.8 $\pm$ 0.41	19.28 $\pm$ 0.37	20.85 $\pm$ 0.35	11.51 $\pm$ 0.28	16.64 $\pm$ 0.44
P-Value	<0.001	0.009	<0.001	<0.001		

Physiological results

1 - C-Reactive Protein

Table (4) showed a significant increase at the level of ($P < 0.001$) in the average values of C-reactive protein between the smoking study groups and the control group. The first group with an average age of (24.3 $\pm$ 0.73) recorded a CRP ratio (8.2 $\pm$ 1.3). The second group with an average (34.3 $\pm$ 0.69) was (10.6 $\pm$ 0.72). The third was an average age of (48.3 $\pm$ 1.06) at percentage (9.8 $\pm$ 0.18), while the control group CRP percentage was 6.93 $\pm$ 0.98. The normal range for C-reactive protein was about 10 mg/L (Dhingra et al., 2007).

2.- Lead (pb)

Table (4) showed a significant increase at the level of ($p < 0.001$) for the concentration of lead in the blood of the smoking station workers compared to the control group. The third category with an average age of 48.3 $\pm$ 1.06 had the highest lead (32.9 $\pm$ 0.99) ppm. It is followed by the second category with an average age of 34.3 $\pm$ 0.69 by (29.9 $\pm$ 1.45) ppm. Then, the first category (average age of 24.3 $\pm$ 0.73) was 27.6 $\pm$ 1.26 ppm compared to the control group at a lead concentration of (14.9 $\pm$ 1.03) ppm

Table (4) Average levels of some variables between working and non-working groups in gas stations for smokers

	Non-working	First category (0-5) years	Category II (5-10) years	Category III (over 10 years old)	P-Value 0.05
Age(year)	45.2 ± 0.68	24.3 ± 0.73	34.3 ± 0.69	48.3 ± 1.06	
Pb	14.9 ± 1.03	27.6 ± 1.26	29.9 ± 1.45	32.9 ± 0.99	<0.001 S
CRP	6.93 ± 0.98	8.2 ± 1.3	10.6 ± 0.72	9.8 ± 0.18	0.009 S

4. Discussion

4.1 Environmental study

The normal range of electrical conductivity in the aqueous extract of ordinary soils ranges between (2-20) mmol/cm(Kirkby, 1984). When comparing the results of the study with normal ranges, we note that the soils in filling stations are located within the soils with very little salinity, i.e. in the range of (0-2) mmol / cm. This is consistent with Al-Azzawi (2005) as he stated that the soil of Kirkuk province has very little to low salinity, and in some areas the salinity is very high.

The current study showed that there are PH significant differences in all stations and months, as the high rates in the winter may be caused by insufficient rain to wash the bases from the surface layer. The lack of natural decomposition of organic materials and the rise of water with capillary property and evaporation are another contributing factor, leaving the bases on the surface layer(Al-Hammad, 2005). Another reason is that these soils contain a percentage of ions for bicarbonate and soluble magnesium bicarbonate, which contribute to the base PH in order to precipitate calcium and magnesium carbonate(Mane et al., 2022).

The high concentration of lead in the studied stations may be attributed to the density of traffic for cars and the resulting combustion of fuel containing TEL or Tetramethyl lead used to mitigate engine cracking. This increased the rates of lead pollution in the surrounding environment(Al-Obeidi et al., 2015). It also agreed with the results of the study of Al-Obeidi et al. (2015), which measured the concentrations of lead in the soil of gas stations in Tikrit governorate and showed significant differences compared to the control area which is away from the stations.

4.2 Physiological study

A rise in the CRP rate of smoking workers was observed compared to the control group, but these percentages are all within the normal range. It may be attributed to simple infections in the body due to their exposure to environmental pollutants resulting from car exhaust and the accumulation of lead inside their bodies. It may also be caused by smoking because of its great health damage to smokers. However, after a general CRP, the exact location of infections was not determined which necessitates other diagnostic tests if it rises above normal range to obtain a more accurate diagnosis(Ghanem et al., 2009).

The current study showed a rise in lead concentrations among smokers working in gas stations. In addition, there is a positive correlation between years of exposure and the concentration of lead in the blood rose because metals enter the human body through cigarette smoke, which is an important source of many heavy metal pollutants, including (lead). They are transported through the blood to the body parts. The high concentration of lead in the blood varies according to the type of cigarettes. For example, Saudi cigarettes contain 2.46 µg/g as

indicated by (Ashraf et al., 2012), and thus smoking increase lead concentrations in the blood of smokers (Alrobaian & Arida, 2019). The number of cigarettes and the duration of smoking have a role in increasing lead concentrations (Hassan et al., 2015; Rhainds & Levallois, 1997). Also, the reason for the high concentrations of lead in the blood of smoking workers may be attributed to their exposure in large proportions to car exhaust emissions, which are one of the main sources of air pollution and blood with lead.

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